

DIESEL: ENGINE

COURSE DESCRIPTION

Diesel: Engine is a course offering training in the testing and repairing of diesel engines and related systems. The course introduces fundamental principles of diesel engine operation. Students will learn to perform inspections, tests, and measurements for diagnosis and to perform needed repairs. Course content prepares students to continue in post secondary education, for advanced training in diesel service technology, for entry level employment in diesel engine repair and to take the ASE written test for Diesel Engine.

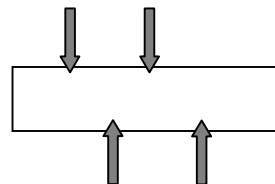
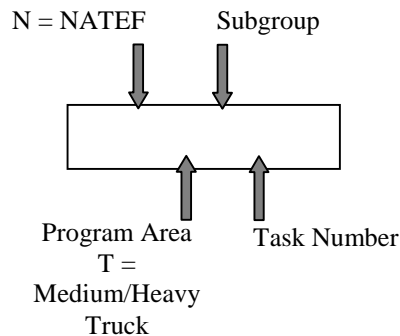
Prerequisite(s): Diesel: Electronics, Algebra I or Math for Technology II, Physical Science or Principles of Technology I

Required: A minimum of 215 hours must be dedicated to diesel engines to meet minimum standards set by NATEF.

Recommended Credits: 2

Recommended Grade Level(s): 11th or 12th

Notes: Course is aligned with NATEF tasks list for medium/heavy trucks and AYES curriculum. Items have been organized based on the requirements of the state-required course description format. NATEF tasks are referenced with the corresponding Performance Standards. Additional cognitive objectives covered by the AYES curriculum are also referenced. Codes are as follows:



DIESEL: ENGINE STANDARDS

- 1.0 Students will demonstrate leadership, citizenship, and teamwork skills required for success in the school, community, and workplace.
- 2.0 Students will demonstrate diesel technology safety practices, including Occupational Safety and Health Administration (OSHA) and Environmental Protection Agency (EPA) requirements for a diesel repair facility.
- 3.0 Students will properly perform general engine diagnosis.
- 4.0 Students will properly diagnose and repair cylinder heads and valve trains.
- 5.0 Students will properly diagnose and repair the diesel engine block.
- 6.0 Students will properly diagnose and repair lubrication systems.
- 7.0 Students will properly diagnose and repair cooling system.
- 8.0 Students will properly diagnose and repair air induction and exhaust systems.
- 9.0 Students will properly diagnose and repair fuel systems.
- 10.0 Students will properly diagnose and repair engine brakes.
- 11.0 Students will demonstrate communication skills required in the diesel service industry.
- 12.0 Students will demonstrate interpersonal and employability skills required in the diesel service industry.

DIESEL: ENGINE

STANDARD 1.0

Students will demonstrate leadership, citizenship, and teamwork skills required for success in the school, community, and workplace.

LEARNING EXPECTATIONS

The student will:

- 1.1 Demonstrate positive leadership skills in the classroom and community.
- 1.2 Participate in SkillsUSA-VICA as an integral part of classroom instruction.
- 1.3 Investigate how technology has made an impact on diesel engine performance in the past 2 years.
- 1.4 Construct a job search network.

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

- 1.1 Serves as a volunteer in the community.
- 1.2.A Applies the points of the creed to personal and professional situations.
- 1.2.B Assists with an officer campaign with Tennessee SkillsUSA-VICA.
- 1.3.A Writes a technical report that shows technological advancements in diesel engine performance and repair.
- 1.4.A Refines employment portfolio.
- 1.4.B Completes a job search for employment opportunities.
- 1.4.C Researches job search opportunities through SkillsUSA-VICA.

SAMPLE PERFORMANCE TASKS

- Create a leadership inventory and use it to conduct a personal assessment.
- Participate in various SkillsUSA-VICA programs and/or competitive events.
- Analyze entry-level job skills and demonstrate proficiency in each skill.
- Implement an annual program of work.
- Attend a professional organization meeting.
- Participate in the Community Service competition with SkillsUSA-VICA.
- Places resume on national job search Website with SkillsUSA-VICA at www.skillsusa.org.
- Attend a professional organization meeting.
- Participate in the American Spirit Award competition with SkillsUSA-VICA.

INTEGRATION LINKAGES

SkillsUSA-VICA, *Professional Development Program*, SkillsUSA-VICA, Communications and Writing Skills, Teambuilding Skills, Research, Language Arts, Sociology, Psychology, Math, Math for Technology, Applied Communications, Social Studies, Problem Solving, Interpersonal Skills, Employability Skills, Critical-Thinking Skills, SCANS (Secretary's Commission on Achieving Necessary Skills), Chamber of Commerce, Colleges, Universities, Technology Centers, and Employment Agencies

DIESEL: ENGINE

STANDARD 2.0

Students will demonstrate diesel technology safety practices, including Occupational Safety and Health Administration (OSHA) and Environmental Protection Agency(EPA) requirements for a diesel repair facility.

LEARNING EXPECTATIONS

The student will:

- 2.1 Determine the safe and correct application and disposal for chemicals used in a diesel engine repair facility.
- 2.2 Use protective clothing, eye and ear protection, and safety equipment.
- 2.3 Use fire protection equipment.
- 2.4 Follow OSHA and EPA regulations affecting engine performance service technology.
- 2.5 Respond to manufacturer safety communications concerning diesel engine repair and performance systems and components.

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

- 2.1.A Conforms to federal, state, and local regulations when handling, storing, and disposing of chemicals.
- 2.1.B Ensures proper ventilation for chemical use.
- 2.1.C Locates first aid supplies.
- 2.2.A Demonstrates proper usage of special safety equipment used in performing diesel engine repair.
- 2.2.B Selects and uses the appropriate protective clothing for a given task.
- 2.2.C Demonstrates the use of eye, ear, and respiratory protection.
- 2.3.A Distinguishes the proper fire extinguisher for each class of fire.
- 2.3.B Demonstrates the proper use of a fire extinguisher and other fire protection equipment.
- 2.4.A Locates regulatory information.
- 2.4.B Extracts information from Material Safety Data Sheets.
- 2.4.C Complies with relevant regulations and standards.
- 2.4.D Passes with 100% accuracy a written examination relating specifically to diesel engine repair safety issues.
- 2.4.E Passes with 100% accuracy a performance examination relating specifically to diesel engine repair tools and equipment.
- 2.4.F Maintains a portfolio record of written safety examinations and equipment examinations for which the student has passed an operational checkout by the instructor.
- 2.5.A Interprets manufacturer safety and recall communications.
- 2.5.B Complies with safety signs and symbols.

SAMPLE PERFORMANCE TASKS

- Assess the diesel engine work area for safety hazards.
- Design a corrections program for identified hazards.
- Model the appropriate protective equipment for an assigned task.

INTEGRATION LINKAGES

Science, Math, Math for Technology, Technology Literacy, Applied Communications, Problem Solving, National Institute for Automotive Service Excellence (ASE), National Automotive Technician Education Foundation (NATEF), AYES curriculum, Occupational Safety and Health Administration (OSHA), Environmental Protection Agency (EPA), SkillsUSA-VICA, Secretary's commission on Achieving Necessary Skills (SCANS)

DIESEL: ENGINE

STANDARD 3.0

Students will properly perform general engine diagnosis.

LEARNING EXPECTATIONS

The student will:

- 3.1 Analyze the function and operation of diesel engines.
- 3.2 Diagnose diesel engines.

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

- 3.1.A Correlates the following concepts with their role in diesel engines:
 - speed
 - work
 - torque
 - horsepower
 - bore
 - stroke
 - displacement
- 3.1.B Calculates the following:
 - displacement.
 - compression ratio.
 - torque and horsepower.
- 3.1.C Differentiates between the following:
 - volumetric versus mass efficiency
 - open combustion chambers versus pre-chambers
 - torque versus torque rise.
- 3.1.D Illustrates the two- and four-stroke cycle of operation.
- 3.1.E Distinguishes the three periods of diesel combustion.
- 3.2.A Inspects fuel, oil, and coolant levels and condition; determines needed action.
- 3.2.B Diagnoses the following and determines needed action:
 - no cranking, cranks but fails to start, hard starting, and starts but does not continue to run problems.
 - surging, rough operation, misfiring, low power, slow deceleration, slow acceleration, and shutdown problems.
 - engine vibration problems.
 - causes of engine fuel, oil, coolant, air, and other leaks.
- 3.2.C Interprets engine noises and determines needed action.
- 3.2.D Observes engine exhaust smoke color and quantity; determines needed action.
- 3.2.E Performs the following tests and determines needed action:
 - air intake system restriction and leakage tests.
 - intake manifold pressure (boost) test.
 - exhaust backpressure test.
 - crankcase pressure test.
- 3.2.F Checks, records, and clears electronic diagnostic codes; monitors electronic data; and determines needed action.

SAMPLE PERFORMANCE TASKS

- Calculate torque and horsepower for a specific engine.
- Diagnose a customer complaint about engine vibration.
- Test crank pressure and determine needed action.
- Using case scenarios follow strategy based diagnostic procedure to verify the complaint, define the problem, isolate the problem, validate the problem, make the repair, and test the repair. Complete a repair order using technical writing skills and calculate salary earnings based on the repair order description and manufacture allowances for each item on the work order. Calculate manufacturer labor operation time used in the diagnostic process.

INTEGRATION LINKAGES

Science, Math, Math for Technology, Technology Literacy, Applied Communications, Problem-Solving, National Institute for Automotive Service Excellence (ASE), National Automotive Technician Education Foundation (NATEF), Occupational Safety and Health Administration (OSHA), Tennessee Occupational Safety and Health Administration (TOSHA), Environmental Protection Agency (EPA), SkillsUSA-VICA, Secretary's Commission on Achieving Necessary Skills (SCANS)

DIESEL: ENGINE

STANDARD 4.0

Students will properly diagnose and repair cylinder heads and valve trains.

LEARNING EXPECTATIONS

The student will:

- 4.1 Analyze the function and operation of diesel engine cylinder heads and valve trains.
- 4.2 Diagnose and repair diesel engine cylinder heads and valve trains.

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

- 4.1.A Examines the functional role and operation of the following:
 - cylinder head
 - engine timing gear train
 - valve seat inserts
 - camshaft
 - cylinder head valves
 - valve rotators
 - valve train components
 - rocker assembly in the engine feedback assembly.
- 4.1.B Illustrates the meaning of the terms component “creep” and “gasket yield”.
- 4.1.C Illustrates the meaning of the term “rocker ratio”.
- 4.1.D Interprets the terminology used to describe camshaft geometry.
- 4.1.E Compares the various types of tappet/cam follower used in diesel engines.
- 4.2.A Removes, cleans, inspects for visible damage, and replaces cylinder head(s) assembly.
- 4.2.B Cleans and inspects threaded holes, studs, and bolts for serviceability; determines needed action.
- 4.2.C Performs the following inspections and determines needed action:
 - Inspects cylinder head for cracks/damage; checks mating surfaces for warpage; checks condition of passages; and inspects core and gallery plugs.
 - Inspects injector sleeves and seals and measures injector tip or nozzle protrusion.
 - Inspects and adjusts valve bridges (crossheads) and guides.
 - Inspects, measures, and replaces/reinstalls overhead camshaft; measures/adjusts end play and backlash.
 - Inspects pushrods, rocker arms, rocker arm shafts, electronic wiring harness, and brackets for wear, bending, cracks, looseness, and blocked oil passages.
 - Inspects cam followers.
- 4.2.D Disassembles cylinder head and inspects valves, guides, seats, springs, retainers, rotators, locks, and seals; determines needed action; and reassembles cylinder head.
- 4.2.E Measures valve head height relative to deck, valve face-to-seat contact, and valve seat concentricity; determines needed action.
- 4.2.F Adjusts valve clearance.

SAMPLE PERFORMANCE TASKS

- Observe and determine necessary action for a cracked cylinder head.
- Remove, clean, inspect, and replace the cylinder head(s) assembly.
- Using case scenarios follow strategy based diagnostic procedure to verify the complaint, define the problem, isolate the problem, validate the problem, make the repair, and test the repair. Complete a repair order using technical writing skills and calculate salary earnings based on the repair order description and manufacture allowances for each item on the work order. Calculate manufacturer labor operation time used in the diagnostic process.

INTEGRATION LINKAGES

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DIESEL: ENGINE

STANDARD 5.0

Students will properly diagnose and repair the diesel engine block.

LEARNING EXPECTATIONS

Students will:

- 5.1 Analyze the function and operation of the engine block.
- 5.2 Diagnose and repair the engine block.

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

- 5.1.A Assesses the advantages or disadvantages of:
 - the different types of cylinder liners used in diesel engines.
 - the trunk and articulating pistons.
 - the Mexican Hat, open combustion chamber design in a direct injection (DI) diesel engine.
- 5.1.B Explores:
 - how cavitation erosion occurs in wet liners.
 - how rings lubricate the cylinder walls and seal the cylinder.
 - the role of connecting rods and their stresses.
 - the normal forces applied to diesel engine crankshafts.
- 5.1.C Illustrates the function of the following:
 - the piston assembly.
 - the harmonic balancer (torsional (vibration damper) and flywheel assemblies.
- 5.1.D Distinguishes among commonly used diesel engine piston rings.
- 5.1.E Determines the conditions required to enable rings to seal the cylinder.
- 5.1.F Expresses the concept of hydrodynamic suspension.
- 5.2.A Makes the following inspections/checks and measurements and determines needed action:
 - Disassembles, cleans, and inspects engine block for cracks/damage; measure mating surfaces for warpage; checks condition of passages, core and gallery plugs; and inspects threaded holes, studs, dowel pins, and bolts for serviceability.
 - Inspects cylinder sleeve counterbore and lower bore and checks bore distortion.
 - Cleans, inspects, and measures cylinder walls or liners for wear and damage.
 - Inspects in-block camshaft bearings for wear and damage.
 - Inspects, measures, and replaces/reinstalls in-block camshaft; measures/adjusts end play.
 - Cleans and inspects crankshaft for surface cracks and journal damage; checks condition of oil passages; checks passage plugs; and measures journal diameter.
 - Inspects main bearings for wear patterns and damage; replaces as needed; checks bearing clearances; checks and adjusts crankshaft end play.
 - Inspects, installs, and times gear train; measures gear backlash.
 - Inspects connecting rod and bearings for wear patterns; measures pistons, pins, retainers, and bushings.
 - Checks condition of piston cooling jets (nozzles).
 - Inspects and measures crankshaft vibration damper.

- Inspects flywheel/flexplate (including ring gear) and mounting surfaces for cracks and wear; and measures runout.
- 5.2.B Removes, inspects, services, and installs pans, covers, vents, gaskets, seals, and wear rings.
- 5.2.C Replaces/reinstalls cylinder liners and seals; checks and adjusts liner height (protrusion).
- 5.2.D Determines piston-to-cylinder wall clearance; checks ring-to-groove clearance and end gap; installs rings on pistons.
- 5.2.E Assembles pistons and connecting rods; installs in block; installs rod bearings and checks clearances.
- 5.2.F Inspects, installs, and aligns flywheel housing.

SAMPLE PERFORMANCE TASKS

- Remove pan and determine and perform required service.
- Diagram the components of an engine block.
- Clean cylinder liners and determine if repair is needed.
- Using case scenarios follow strategy based diagnostic procedure to verify the complaint, define the problem, isolate the problem, validate the problem, make the repair, and test the repair. Complete a repair order using technical writing skills and calculate salary earnings based on the repair order description and manufacture allowances for each item on the work order. Calculate manufacturer labor operation time used in the diagnostic process.

INTEGRATION LINKAGES

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DIESEL: ENGINE

STANDARD 6.0

Students will properly diagnose and repair lubrication systems.

LEARNING EXPECTATIONS

The student will:

- 6.1 Analyze the function and operation of diesel engine lubrication systems.
- 6.2 Diagnose and repair diesel engine lubrication systems.

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

- 6.1.A Examines the function of the main components in a typical diesel engine lubrication circuit/lubricating system.
- 6.1.B Determines the required properties of heavy-duty engine oil.
- 6.1.C Correlates the following concepts with their role in diesel engines:
 - hydrodynamic suspension and
 - positive filtration.
- 6.1.D Describes the operating principles of the following:
 - the pressure-regulating valve and its role in the lubrication circuit.
 - various types of heavy-duty oil filters and their relative operating efficiencies.
 - the two types of oil coolers.
 - the two types of oil pump commonly used on diesel engines.
- 6.1.E Interprets API classifications and SAE viscosity grades.
- 6.1.F Differentiates between full flow and bypass filters.
- 6.2.A Tests engine oil pressure and checks operation of pressure sensor, gauge, and/or sending unit; determines needed action.
- 6.2.B Checks engine oil level and condition; determines needed action.
- 6.2.C Inspects the following and performs necessary action:
 - oil pump, drives, inlet pipes, and pick-up screens.
 - oil pressure regulator valve(s), by-pass and pressure relief valve(s), oil thermostat, and filters.
 - turbocharger lubrication system.
- 6.2.D Inspects, cleans, and tests oil cooler and components; determines needed action.
- 6.2.E Determines proper lubricant and performs oil and filter change.

SAMPLE PERFORMANCE TASKS

- Change oil filter.
- Diagram an engine lubrication system.
- Check engine oil and add or change as indicated.
- Using case scenarios follow strategy based diagnostic procedure to verify the complaint, define the problem, isolate the problem, validate the problem, make the repair, and test the repair. Complete a repair order using technical writing skills and calculate salary earnings based on the repair order description and manufacture allowances for each item on the work order. Calculate manufacturer labor operation time used in the diagnostic process.

INTEGRATION LINKAGES

Science, Math, Math for Technology, Technology Literacy, Applied Communications, Problem-Solving, National Institute for Automotive Service Excellence (ASE), National Automotive Technician Education Foundation (NATEF), Occupational Safety and Health Administration (OSHA), Tennessee Occupational Safety and Health Administration (TOSHA), Environmental Protection Agency (EPA), SkillsUSA-VICA, Secretary's Commission on Achieving Necessary Skills (SCANS)

DIESEL: ENGINE

STANDARD 7.0

Students will properly diagnose and repair cooling systems.

LEARNING EXPECTATIONS

The student will:

- 7.1 Analyze the function and operation of a diesel engine cooling system.
- 7.2 Diagnose, service, and repair a diesel engine cooling system.

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

- 7.1.A Examines the roles and operations of the following in the engine cooling system:
 - cooling system radiator cap.
 - water pump/centrifugal pump.
 - the different types of thermostats.
 - shutters and engine cooling fans.
 - coolant filters.
 - coolant level warning indicator.
 - thermatic type viscous fan hub.
- 7.1.B Correlates the concepts of conduction, convection, and radiation with their roles in engine cooling.
- 7.1.C Compares the advantages and disadvantages of the three types of coolant used in current highway diesel engines.
- 7.1.D Examines the properties of a heavy-duty antifreeze and supplemental cooling additive (SCA) package.
- 7.1.E Differentiates between the types of heavy-duty radiator in use including downflow, crossflow and counterflow.
- 7.1.F Compares the types of temperature gauges used in current highway diesel engines and illustrate how their signals are output.
- 7.2.A Checks engine coolant level, condition, and consumption; determines needed action.
- 7.2.B Tests coolant temperature and checks operation of temperature sensor, gauge, and/or sending unit; determines needed action.
- 7.2.C Inspects the following and replaces as needed:
 - drive belts, tensioners, and pulleys.
 - thermostat(s), by-passes, housing(s), and seals.
 - coolant conditioner/filter assembly (for leaks); valves, lines, and fittings, water pump, hoses, and idler pulley.
 - thermostatic cooling fan system and fan shroud.
- 7.2.D Tests coolant for freeze protection and additive package concentration; adjusts as needed.
- 7.2.E Recovers, flushes, and refills with recommended coolant/additive package; bleeds cooling system.
- 7.2.F Inspects, cleans, and pressure tests radiator, pressure cap, tank(s), and recovery systems; determines needed action.

SAMPLE PERFORMANCE TASKS

- Diagram the engine cooling system.
- Check coolant and performs any service indicated.
- Using case scenarios follow strategy based diagnostic procedure to verify the complaint, define the problem, isolate the problem, validate the problem, make the repair, and test the repair. Complete a repair order using technical writing skills and calculate salary earnings based on the repair order description and manufacture allowances for each item on the work order. Calculate manufacturer labor operation time used in the diagnostic process.

INTEGRATION LINKAGES

Science, Math, Math for Technology, Technology Literacy, Applied Communications, Problem-Solving, National Institute for Automotive Service Excellence (ASE), National Automotive Technician Education Foundation (NATEF), Occupational Safety and Health Administration (OSHA), Tennessee Occupational Safety and Health Administration (TOSHA), Environmental Protection Agency (EPA), SkillsUSA-VICA, Secretary's Commission on Achieving Necessary Skills (SCANS)

DIESEL: ENGINE

STANDARD 8.0

Students will properly diagnose and repair air induction and exhaust systems.

LEARNING EXPECTATIONS

The student will:

- 8.1 Analyze the function and operation of diesel air induction and exhaust systems.
- 8.2 Diagnose, service, and repair diesel air induction and exhaust systems.

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

- 8.1.A Examines the intake and exhaust system components that comprise the engine breathing circuit.
- 8.1.B Describes how intake air is routed to the engine cylinders and exhaust gasses are routed to the tailpipe.
- 8.1.C Illustrates the roles, functions, and operations of the following:
 - the main sub-components on a truck diesel engine turbocharger.
 - a Roots blower.
 - the different types of charge air coolers (and their relative efficiencies).
 - the exhaust muffler (silencer).
 - the truck catalytic converter.
- 8.1.D Relates the parallel port and crossflow valve configurations and valve seat angle to breathing efficiency and cylinder gas dynamics.
- 8.1.E Illustrates the following terms:
 - “tuned” (in relation to intake and exhaust manifold design).
 - “thermocouple pyrometer” (in relation to its use on a diesel engine).
- 8.1.F Compares the different types of cold engine starting aids used in a diesel engine.
- 8.2.A Inspects the following and determines/performs needed action:
 - turbocharger, wastegate, and piping systems.
 - preheater/inlet air heater, or glow plug system and controls.
- 8.2.B Tests operation of exhaust mounted engine warm up device; determines needed action. N-TII-F-2
- 8.2.C Removes and reinstalls turbocharger and wastegate.
- 8.2.D Inspects intake manifold, gaskets, and connections; replaces as needed.
- 8.2.E Inspects, cleans, and tests aftercooler (intercooler) and charges air cooler assemblies; replaces as needed.
- 8.2.F Inspects exhaust manifold, piping, mufflers, and mounting hardware; repairs or replaces as needed.

SAMPLE PERFORMANCE TASKS

- Inspect turbocharger, perform indicated service/repair, and reinstall.
- Diagnose and replace cracked exhaust manifold.
- Using case scenarios follow strategy based diagnostic procedure to verify the complaint, define the problem, isolate the problem, validate the problem, make the repair, and test the repair. Complete a repair order using technical writing skills and calculate salary earnings based on the repair order description and manufacture allowances for each item on the work order. Calculate manufacturer labor operation time used in the diagnostic process.

INTEGRATION LINKAGES

Science, Math, Math for Technology, Technology Literacy, Applied Communications, Problem-Solving, National Institute for Automotive Service Excellence (ASE), National Automotive Technician Education Foundation (NATEF), Occupational Safety and Health Administration (OSHA), Tennessee Occupational Safety and Health Administration (TOSHA), Environmental Protection Agency (EPA), SkillsUSA-VICA, Secretary's Commission on Achieving Necessary Skills (SCANS)

DIESEL: ENGINE

STANDARD 9.0

Students will properly diagnose and repair fuel systems.

LEARNING EXPECTATIONS

The student will:

- 9.1 Analyze the function and operation of diesel engine fuel systems.
- 9.2 Diagnose and repair diesel engine fuel supply systems.
- 9.3 Analyze the function and operation of mechanical fuel injection systems.
- 9.4 Diagnose and repair mechanical fuel injection systems.
- 9.5 Analyze the function and operation of electronic fuel management systems.
- 9.6 Diagnose and repair electronic fuel management systems.

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

- 9.1.A Correlates the following terms with their roles in fuel systems:
 - specific gravity
 - viscosity
 - cetane rating
 - cloud point
 - pour point
- 9.1.B Examines the role of primary and secondary fuel filters and explains how a water separator works.
- 9.1.C Differentiates between the hydro-mechanical injection operating principles of timing, pressurization metering, atomization, and distribution.
- 9.1.D Explores atomization and the droplet sizing factors required for a direct injected diesel engine.
- 9.1.E Compares the three types of hydraulic injector nozzle and identifies the primary sub-components of a nozzle assembly.
- 9.1.F Examines the principles of operation of the following:
 - poppet, pintle and multi-orifice nozzles.
 - transfer or charge pump.
- 9.2.A Checks fuel level and quality; determines needed action.
- 9.2.B Inspects fuel tanks, vents, caps, mounts, valves, screens, crossover system, supply and return lines and fittings; determines needed action.
- 9.2.C Inspects, cleans, and tests fuel transfer (lift) pump, pump drives, screens, fuel/water separators/indicators, filters, heaters, coolers, ECM cooling plates, and mounting hardware; determines needed action.
- 9.2.D Inspects and tests low pressure regulator systems (check valves, pressure regulator valves, and restrictive fittings); determines needed action.
- 9.2.E Checks fuel system for air; determines needed action; primes and bleeds fuel system; checks primer pump.
- 9.3.A Analyzes the major components and operating principles of the following:
 - in-line type port-helix metering injection pump.
 - distributor-type injection pump.
 - Caterpillar and Detroit Diesel Corporation (DDC) mechanical unit injector (MUI) system.
 - Cummins PT-type metering injection pump.

- 9.3.B Examines metering and the factors that control it.
- 9.3.C Illustrates the operation of injection pump peripherals including aneroid devices, altitude compensators and variable timing/timing advance mechanisms.
- 9.3.D Determines how MUI effective stroke is varied to control injected fuel quantity.
- 9.3.E Points out the components that link the MUIs with the governor assembly.
- 9.3.F Illustrates the function and operation of a hydro-mechanical governor on a diesel engine.
- 9.4.A Performs on-engine inspections, tests, and adjustments, and:
 - checks and adjusts timing or replaces and times a distributor (rotary) type injection pump; determines needed action.
 - checks and adjusts timing or replaces and times an in-line type injection pump; determines needed action.
 - replaces a PT-type injection pump and injectors as needed.
- 9.4.B Inspects and adjusts throttle control linkage; determines needed action.
- 9.4.C Inspects air/fuel ratio control systems; determines needed action.
- 9.4.D Inspects, tests, and adjusts engine fuel shut-down devices and controls; determines needed action.
- 9.4.E Inspects high pressure injection lines, hold downs, fittings and seals; replaces as needed.
- 9.5.A Analyzes the operation and major components of the following:
 - Distributor-type electronic injection pump system.
 - Caterpillar PEEC Fuel Injection System on a 3406 engine (and express why it is a partial authority system.)
 - Detroit Diesel Corporation (DDC) Detroit Diesel Electronic Controls (DDEC) system.
 - Caterpillar full authority, advanced electronic engine management system (ADEMS).
 - Cummins CELECT System (differentiating between CELECT and CELECT Plus.)
 - Electronic Unit Pump (EUP) on the DDC Series 55 and Mack Trucks E7.
 - Cummins HPI-TP Electronic Common Rail fuel system on a Signature 600 engine.
 - MACK V-MAC II Fuel Injection Systems (differentiating between V-MAC II and I.)
- 9.5.B Examines how Mack Trucks and Bosch adapted an in-line, port helix metering injection pump for computerized management and control.
- 9.5.C Illustrates the principles of operation of the Detroit Diesel Corporation (DDC) electronic unit injector (EUI) and assesses the importance of programming EUI calibration data to the electronic computer manager (ECM).
- 9.5.D Distinguishes the four primary sub-systems that manage a hydraulic electronic unit injector (HEUI) engine's output.
- 9.5.E Points out the major components and the four primary sub-systems of the Hydraulic Electronic Unit Injector (HEUI) common rail systems and illustrates their operation.
- 9.6.A Performs the following inspections and tests:
 - Inspects and tests power and ground circuits and connections; determines needed action.
 - Inspects and replaces electrical connector terminals, seals, and locks.
 - Inspects and tests sensors, controls, actuator components, and circuits; adjusts or replaces as needed.
 - Performs cylinder contribution test utilizing recommended electronic diagnostic tool.
 - Performs engine timing sensor calibration (if applicable).
 - Performs on-engine inspections and tests on hydraulic electronic unit injectors (HEUI) and system electronic controls; determines needed action.

- Performs on-engine inspections and tests on hydraulic electronic unit injector (HEUI) high-pressure oil control system; determines needed action; determines needed action.
 - Performs on-engine inspections and tests on distributor-type injection pump electronic controls.
 - Performs on-engine inspections and tests on in-line type injection pump electronic controls; determines needed action.
- 9.6.B Interfaces with vehicle's on-board computer; performs diagnostic procedures using recommended electronic diagnostic equipment and tools (to include PC based software and/or data scan tools); determines needed action.
- 9.6.C Locates and uses relevant service information (to include diagnostic procedures, flow charts, and wiring diagrams).
- 9.6.D Using recommended electronic diagnostic tools (to include PC based software and/or data scan tools), accesses and changes customer parameters.
- 9.6.E Inspects, tests, and adjusts electronic unit injectors (EUI); determines needed action.
- 9.6.F Removes and installs electronic unit injectors (EUI) and related components; recalibrates electronic computerized management (ECM).

SAMPLE PERFORMANCE TASKS

- Diagnose problem with fuel system and perform indicated action.
- Change fuel filter.
- Use appropriate service information to properly diagnose electronic fuel management system.
- Using case scenarios follow strategy based diagnostic procedure to verify the complaint, define the problem, isolate the problem, validate the problem, make the repair, and test the repair. Complete a repair order using technical writing skills and calculate salary earnings based on the repair order description and manufacture allowances for each item on the work order. Calculate manufacturer labor operation time used in the diagnostic process.

INTEGRATION LINKAGES

Communication Skills, Teamwork Skills, Computer Skills, Reading and Writing Skills, Language Arts, Problem Solving, Interpersonal Skills, Employability Skills, Critical-Thinking Skills, National Institute for Automotive Service Excellence, National Automotive Technician Education Foundation, Occupational Safety and Health Administration (OSHA), Tennessee Occupational Safety and Health Administration (TOSHA), Environmental Protection Agency (EPA), SkillsUSA-VICA, Secretary's Commission on Achieving Necessary Skills (SCANS)

DIESEL: ENGINE

STANDARD 10.0

Students will properly diagnose and repair engine brakes.

LEARNING EXPECTATIONS

The student will:

- 10.1 Analyze the function and operation of diesel engine brakes.
- 10.2 Diagnose and repair engine brakes.

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

- 10.1.A Differentiates between the three types of engine brakes used on diesel engines.
- 10.1.B Illustrates the operation of diesel engine brakes.
- 10.2.A Inspects and adjusts engine/exhaust brakes; determines needed action.
- 10.2.B Inspects, tests, and adjusts engine/exhaust brake control circuits, switches, and solenoids; repairs or replaces as needed.
- 10.2.C Inspects engine/exhaust brake housing, valves, seals, screens, lines, and fittings; repairs or replaces as needed.

SAMPLE PERFORMANCE TASKS

- Inspect engine brake components and perform indicated action.
- Compare the operation of the three types of diesel engine brakes.
- Using case scenarios follow strategy based diagnostic procedure to verify the complaint, define the problem, isolate the problem, validate the problem, make the repair, and test the repair. Complete a repair order using technical writing skills and calculate salary earnings based on the repair order description and manufacture allowances for each item on the work order. Calculate manufacturer labor operation time used in the diagnostic process.

INTEGRATION LINKAGES

Communication Skills, Teamwork Skills, Computer Skills, Reading and Writing Skills, Language Arts, Problem Solving, Interpersonal Skills, Employability Skills, Critical-Thinking Skills, National Institute for Automotive Service Excellence, National Automotive Technician Education Foundation, Occupational Safety and Health Administration (OSHA), Tennessee Occupational Safety and Health Administration (TOSHA), Environmental Protection Agency (EPA), SkillsUSA-VICA, Secretary's Commission on Achieving Necessary Skills (SCANS)

DIESEL: ENGINE

STANDARD 11.0

Students will demonstrate communication skills required in the diesel service industry.

LEARNING EXPECTATIONS

The student will:

- 11.1 Communicate and comprehend oral and written information typically occurring in diesel engine repair service.
- 11.2 Solve diesel engine service problems and make decisions using a logical process.
- 11.3 Use teamwork skills to accomplish goals, solve problems, and manage conflict within groups.

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

- 11.1.A Interprets and uses written information in common job formats, such as tables, charts, and reference materials, manuals, and manufacturer referring to diesel engine repair.
- 11.1.B Interprets and uses graphical information such as blueprints, electrical schematics, process control schematics, flow diagrams, and other diesel technology diagrams referring to diesel engine repair.
- 11.1.C Uses electronic resources to obtain service and other information concerning diesel engine performance.
- 11.1.D Analyzes information obtained from various sources to determine a diagnostic approach.
- 11.1.E Communicates clearly and appropriately in oral and written form.
- 11.1.F Interprets a diesel engine repair order.
- 11.2.A Develops a hypothesis regarding the cause of an engine performance problem.
- 11.2.B Tests the hypothesis to determine the solution to the engine performance problem.
- 11.2.C Creates, evaluates, and revises as needed a plan to resolve an engine performance problem.
- 11.2.D Implements strategy based diagnostic procedure by verifying the complaint, defining the problem, isolating the problem, validating the problem, making repairs, and testing the repairs in a diesel engine.
- 11.3.A Serves in each of the functional roles of a team.
- 11.3.B Resolves conflicts within a group.
- 11.3.C Demonstrates appropriate and positive examples of giving and accepting criticism.
- 11.3.D Modifies behavior or revises work based on appropriate criticism.
- 11.3.E Solves problems in cooperation with other members of a group.
- 11.3.F Evaluates the role of the diesel engine repair technician within the organizational system of a dealership or fleet shop.

SAMPLE PERFORMANCE TASKS

- Complete a diesel engine repair order and calculate salary based on manufacture labor operation time.
- Use reference materials to determine procedures for diagnosing and testing engines.
- Work as a team member to develop a diagnostic strategy.
- Use blueprints and diagrams to execute a task.

INTEGRATION LINKAGES

Communication Skills, Teamwork Skills, Computer Skills, Reading and Writing Skills, Language Arts, Problem Solving, Interpersonal Skills, Employability Skills, Critical-Thinking Skills, National Institute for Automotive Service Excellence, National Automotive Technician Education Foundation, Occupational Safety and Health Administration (OSHA), Tennessee Occupational Safety and Health Administration (TOSHA), Environmental Protection Agency (EPA), SkillsUSA-VICA, Secretary's Commission on Achieving Necessary Skills (SCANS)

DIESEL: ENGINE

STANDARD 12.0

Students will demonstrate interpersonal and employability skills required in the diesel service industry.

LEARNING EXPECTATIONS

The student will:

- 12.1 Evaluate career goals and establish long-term goals.
- 12.2 Demonstrate attitudes conducive to workplace success.
- 12.3 Maintain a neat and orderly work area.
- 12.4 Assess implications of diversity for communities, workplaces, and manufacturers.
- 12.5 Develop personal financial skills.
- 12.6 Develop individual time management and work sequencing skills relating to diesel engine repair procedures.

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

- 12.1.A Explores opportunities for advanced training.
- 12.1.B Assesses the potential impact of an individual's educational level on an organizational system.
- 12.1.C Infers the relationship between work ethics, education, and personal job success.
- 12.2.A Judges which attitudes and behaviors are conducive to success.
- 12.2.B Models customer service skills.
- 12.3.A Keeps work area organized and free from clutter according to NATEF and OSHA standards.
- 12.3.B Deduces the correlation between a clean orderly work environment and successful and efficient job performance and earnings.
- 12.4.A Points out potential benefits and problems that may arise from diversity in the diesel service workplace, including manufacturer diversity.
- 12.4.B Devises solutions to problems arising from gender, cultural, racial, and religious diversity.
- 12.5.A Develops a personal budget.
- 12.5.B Sets personal financial goals.
- 12.6 Displays time management and work sequencing skills in class assignments and work assignments.

SAMPLE PERFORMANCE TASKS

- Maintain an orderly work area.
- Consistently arrive at class on time.
- Participate in an internship in a dealership or fleet shop.
- Resolve an interpersonal conflict in the classroom.

INTEGRATION LINKAGES

Science, Math, Math for Technology, Technology Literacy, Applied Communications, Problem-Solving, National Institute for Automotive Service Excellence (ASE), National Automotive Technician Education Foundation (NATEF), Occupational Safety and Health Administration (OSHA), Tennessee Occupational Safety and Health Administration (TOSHA), Environmental Protection Agency (EPA), SkillsUSA-VICA, Secretary's Commission on Achieving Necessary Skills (SCANS)

DIESEL: ENGINE

SAMPLING OF AVAILABLE RESOURCES

T2 Diesel Engine Curriculum Module, AYES Corporation, www.ayes.org

2001 Medium/Heavy Duty Truck Task List, National Automotive Technicians Education Foundation (NATEF), www.natef.org

Diesel Technology: Workplace Skills, Instructional Materials Laboratory (IML), University of Missouri

Diesel Technology: Safety Skills, Instructional Materials Laboratory (IML), University of Missouri

Curriculum Integrator, CORD Communications, Waco, Texas 76798

Diesel Technology, Goodheart-Willcox, 2001.